## WHAT IS CLAIMED IS:

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- 1. A bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.
- 2. The compact of claim 1, wherein said compact has a Vickers hardness of about 41-68 GPa.
- 3. The compact of claim 1, wherein said compact has a Vickers hardness of about 50-68 GPa.
- 4. The compact of claim 1, wherein said compact has a Vickers hardness of about 62-68 GPa.
- 5. The compact of claim 1, wherein said compact has a Vickers hardness of 68 GPa.
- 6. A process for preparing a bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous, diamond-like carbon grain boundaries, comprising the steps of:
  - (a) ball milling a mixture of graphite and hexagonal boron nitride to produce a mixture of amorphous and/or nanocrystalline graphitic carbon and boron nitride;
  - (b) encapsulating the ball-milled mixture; and
  - (c) sintering the encapsulated ball-milled mixture at a pressure of about 5-25 GPa and a temperature of about 1000-2500 K, thereby producing a bulk, superhard nanocomposite compact consisting essentially of nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.
- 7. The process of claim 6, wherein the ball milled mixture of graphite hexagonal boron nitride consists essentially of about 1-4 parts graphite to about 1 part hexagonal boron nitride.

- 8. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 1 part graphite to about 1 part hexagonal boron nitride.
- 9. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 2 parts graphite to about 1 part hexagonal boron nitride.
- 10. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of 4 parts graphite to about 1 part hexagonal boron nitride.
- 11. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 10-25 GPa and at a temperature of about 2000-2500 K.
- 12. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 15-25 GPa and at a temperature of about 2000-2500 K.
- 13. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 16-25 GPa and at a temperature of about 2100-2500 K.
- 14. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2000-2500 GPa.
- 15. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2100-2400 K.
- 16. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20 GPa and at a temperature of about 2000-2400 K.
- 17. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 25 GPa and at a temperature of about 2100-2300 K.

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- 18. The process of claim 6, wherein step (b) comprises encapsulating the amorphous mixture in capsule comprising platinum, gold, rhenium, or boron nitride.
- 19. The process of claim 7, wherein said compact has a Vickers hardness of about 41-68 GPa.
- 20. The process of claim 7, wherein said compact has a Vickers hardness of about 50-68 GPa.
- 21. The process of claim 7, wherein said compact has a Vickers hardness of about 62-68 GPa.
- 22. The process of claim 7, wherein said compact has a Vickers hardness of 68 GPa.
- 23. A bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous diamond-like carbon grain boundaries produced by the process comprising the steps of:
  - (a) ball milling a mixture of graphite and hexagonal boron nitride to produce a mixture of amorphous and/or nanocrystalline graphitic carbon and boron nitride;
  - (b) encapsulating the ball-milled mixture; and
  - (c) sintering the encapsulated ball-milled mixture at a pressure of about 5-25 GPa and a temperature of about 1000-2500 K, thereby producing a bulk, superhard nanocomposite compact consisting essentially of nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.
- 24. The compact of claim 23, wherein the ball milled mixture of graphite hexagonal boron nitride consists essentially of about 1-4 parts graphite to about 1 part hexagonal boron nitride.
- 25. The compact of claim 24, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 2 parts graphite to about 1 part hexagonal boron nitride.

- 26. The compact of claim 24, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 4 parts graphite to about 1 part hexagonal boron nitride.
- 27. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 10-25 GPa and at a temperature of about 2000-2500 K.
- 28. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 15-25 GPa and at a temperature of about 2000-2500 K.
- 29. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 16-25 GPa and at a temperature of about 2100-2500 K.
- 30. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2000-2500 GPa.
- 31. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2100-2400 K.
- 32. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20 GPa and at a temperature of about 2000-2400 K.
- 33. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 25 GPa and at a temperature of about 2100-2300 K.
- 34. The process of claim 24, wherein said compact has a Vickers hardness of about 41-68 GPa.
- 35. The process of claim 24, wherein said compact has a Vickers hardness of about 50-68 GPa.
- 36. The process of claim 24, wherein said compact has a Vickers hardness of about 62-68 GPa.

- 37. The process of claim 24, wherein said compact has a Vickers hardness of 68 GPa.
- 38. The bulk, superhard, nanocomposite compact of claim 23, wherein step (b) comprises encapsulating the ball-milled mixture in capsule comprising platinum, gold, rhenium, or boron nitride.
- 39. A machining tool comprising a bulk, superhard, nanocomposite compact consisting essentially nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.
- 40. The tool of claim 39, wherein said compact has a Vickers hardness of about 41-68 GPa.
- 41. The tool of claim 39, wherein said compact has a Vickers hardness of about 50-68 GPa.
- 42. The tool of claim 39, wherein said compact has a Vickers hardness of about 62-68 GPa.
- 43. The tool of claim 39, wherein said compact has a Vickers hardness of 68 GPa.